

PATENT COOPERATION TREATY

PCT

REC'D 19 MAY 2006

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY PCT

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference WO 21.1214	FOR FURTHER ACTION		See Form PCT/IPEA/416
International application No. PCT/EP2005/000054	International filing date (day/month/year) 04.01.2005	Priority date (day/month/year) 16.01.2004	
International Patent Classification (IPC) or national classification and IPC INV. E21B43/02 E21B33/138			
Applicant SERVICES PETROLIERS SCHLUMBERGER			
1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36. 2. This REPORT consists of a total of 6 sheets, including this cover sheet. 3. This report is also accompanied by ANNEXES, comprising: a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 2 sheets, as follows: <input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions). <input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box. b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).			
4. This report contains indications relating to the following items: <input checked="" type="checkbox"/> Box No. I Basis of the report <input type="checkbox"/> Box No. II Priority <input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability <input type="checkbox"/> Box No. IV Lack of unity of invention <input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement <input type="checkbox"/> Box No. VI Certain documents cited <input type="checkbox"/> Box No. VII Certain defects in the international application <input type="checkbox"/> Box No. VIII Certain observations on the international application			
Date of submission of the demand 30.07.2005		Date of completion of this report 18.05.2006	
Name and mailing address of the international preliminary examining authority: <div style="display: flex; align-items: center;"> <div> European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 </div> </div>		Authorized officer Lehnert, A Telephone No. +31 70 340-4234	



**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2005/000054

Box No. I Basis of the report

1. With regard to the **language**, this report is based on
- ☒ the international application in the language in which it was filed
 - ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of:
 - ☐ international search (under Rules 12.3(a) and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4(a))
 - ☐ international preliminary examination (under Rules 55.2(a) and/or 55.3(a))
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

Description, Pages

1-8 as originally filed

Claims, Numbers

1-18 received on 01.08.2005 with letter of 25.07.2005

Drawings, Sheets

1/4-4/4 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing *(specify):*
- ☐ any table(s) related to sequence listing *(specify):*

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing *(specify):*
- ☐ any table(s) related to sequence listing *(specify):*

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

**INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY**

International application No.
PCT/EP2005/000054

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-18
	No: Claims	
Inventive step (IS)	Yes: Claims	1-18
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-18
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V.

The following documents are referred to in this communication; the numbering will be adhered to in the rest of the procedure:

- D1: WO 01/49971 A (SHELL CANADA LTD ; BP EXPLORATION OPERATING (GB); GUNN ALISTAIR MANSON) 12 July 2001 (2001-07-12)
- D2: EP-A-0 604 988 (PHILLIPS PETROLEUM CO) 6 July 1994 (1994-07-06)
- D3: CHAUVETEAU G; TABARY R; RENARD M; OMARI A: "Controllin In-Situ Gelation of Polyacrylamides by Zirconium for Water Shutoff" SPE INTERNATIONAL SYMPOSIUM ON OILFIELD CHEMISTRY - HOUSTON, TEXAS 16-19 FEBRUARY 1999, SPE 50752, 1999, pages 1-9, XP002293495
- D4: US-A-5 789 351 (MORADI-ARAGHI AHMAD ET AL) 4 August 1998 (1998-08-04)
- D5: US-A-5 642 783 (MORADI-ARAGHI AHMAD ET AL) 1 July 1997 (1997-07-01)
- D6: US-A-5 849 674 (MORADI-ARAGHI AHMAD ET AL) 15 December 1998 (1998-12-15)
- D7: US-A-4 606 407 (SHU PAUL) 19 August 1986 (1986-08-19)
- D8: US-A-5 086 089 (SHU PAUL) 4 February 1992 (1992-02-04)
- D9: US-A-4 670 165 (BROWN JAMES M ET AL) 2 June 1987 (1987-06-02)

1. Novelty

1.1.

Document D1 (see claims 1, 4, 9, 10) discloses a method of stabilising an underground formation surrounding a borehole comprising placing a treatment fluid comprising a crosslinkable polymer (acrylamide copolymers, see claim 4). After placement of the treatment fluid zirconium lactate or zirconium acetate (see claims 9, 10, and page 7, lines 13-15) is pumped into the borehole. The fluids are pumped sequentially into the borehole, an aqueous spacer fluid may be used (see claim 1).

In contrast to the disclosure of D1 the application (claim 1) differs from this state of the art in that first a mixture of crosslinkable polymer and cross-linking agent is used; and in a

second step an activator is added. The activator is not disclosed in D1.

Consequently, the subject-matter of claim 1 is novel (Article 33(1) and 33(2) PCT).

1.2.

Documents D2 - D9 may be used to discuss the novelty of the independent claim 1 as well:

Document D2 discloses the gelation of polyacrylamide solutions with zirconium lactate in underground formations; the polymer, crosslinker and complexing ligand can be injected sequentially.

Document D3 discloses the use of zirconium lactate as a crosslinker to gelate polyacrylamides in borewells.

Document D4 discloses zirconium lactate, used to crosslink acrylamide-containing polymers.

Document D5 discloses the crosslinking of partially hydrolysed polyacrylamides with zirconium lactate.

Document D6 discloses the crosslinking of polyacrylamide using zirconium lactate.

Document D7 discloses the crosslinking of a polyacrylamide using chromium ions for stabilising boreholes

Document D8 discloses the polymerisation of acrylamide polymers using a crosslinker and an activator; Al, Cr, and Zr can be used.

Document D9 discloses the polymerisation of acrylamide polymers, cobalt ions are used as crosslinking agents.

The application (claim 1) differs from this state of the art in that first a mixture of crosslinkable polymer and cross-linking agent is used; and in a second step an activator is

added. There is no activator disclosed in any of the documents D2 to D9.

Consequently, the subject-matter of claim 1 is also novel over D2-D9 (Article 33(1) and 33(2) PCT).

3. Inventive step (claim 1)

Document D1 (see claims 1, 4, 9, 10) discloses a method of stabilising an underground formation surrounding a borehole comprising placing a treatment fluid comprising a crosslinkable polymer (acrylamide copolymers, see claim 4). After placement of the treatment fluid zirconium lactate or zirconium acetate (see claims 9, 10, and page 7, lines 13-15) is pumped into the borehole. The fluids are pumped sequentially into the borehole, an aqueous spacer fluid may be used (see claim 1).

In contrast to the disclosure of D1 the application (claim 1) differs from this state of the art in that first a mixture of crosslinkable polymer and cross-linking agent is used; and in a second step an activator is added. The activator is not disclosed in D1.

The technical effect related to this difference is the second treatment, namely the use of an activator can be carried out while drilling, in contrast to other methods (see description of the application, paragraph [0017]).

As there is no document disclosing the use of an activator in a second step in order to apply a method of stabilizing an underground formation continuously the subject-matter of claim 1 is not obvious to the skilled person.

Thus, the subject-matter of claim 1 discloses an inventive step (Article 33(1) and 33(3) PCT).

4. Dependent claims 2-18

Dependent claims 2-18 meet the requirements of the PCT in respect of novelty and inventive step (Article 33(2) and (3) PCT), because they contain all the features of the inventive independent claim 1 and thus are novel and inventive as well.

EPO - DG 1

01.08.2005

(105)

CLAIMS

- 1 A method of stabilising an underground formation surrounding a borehole comprising placing a treatment fluid in the formation, the treatment fluid comprising cross-linkable polymer and a cross-linking agent, and allowing the treatment fluid to gel in-situ, characterised in that after placement of the treatment fluid in the formation, an activator fluid is pumped into the well to accelerate the crosslinking of the polymer and the development of the gel strength.
- 2 The method of claim 1, wherein the reaction between the activator and the treatment fluid is not exothermic.
- 3 The method of claim 1 or 2, wherein the cross-linkable polymer is a polymer containing acrylamide functional groups.
- 4 The method of claim 3, wherein the polymer comprises polyacrylamide, partially hydrolysed polyacrylamide or copolymers of acrylamides and acrylates.
- 5 The method of claim 3 or claim 4, wherein the polymer is a partially hydrolysed polymer with a molecular weight of around 500,000.
- 6 The method according to any preceding claim, wherein the cross-linking agent is a molecule or complex containing a reactive transition metal cation.
- 7 The method of claim 6, wherein the cross-linking agent is a zirconium lactate solution.
- 8 The method according to any preceding claim, wherein the activator comprises a solution of zirconium chloride or zirconium acetate.
- 9 The method of claim 7, wherein the activator comprises a 5-20% solution of zirconium chloride in seawater.
- 10 A method according to any preceding claim, wherein the activator and/or treatment fluid includes colloidal silica.
- 11 The method according to any preceding claim, wherein the treatment fluid has a viscosity of up to 300 cp.
- 12 The method of drilling a well, wherein the stabilization treatment according to any of claims 1 to 11 is carried out during the drilling of the well.

- 13 The method according to any preceding claim, whereby the treatment fluid and the activator are sequentially into the well through a drill string.
- 14 The method of claim 13, wherein the sequence is repeated.
- 15 The method of claim 13 or claim 14, wherein the treatment fluid and the activator are separated from each other by spacer fluids.
- 16 The method as claimed in any of claims 12 to 15, wherein the fluids are applied to the zone of interest by means of a placement tool placed in the drill string which injects the fluids into the zone of interest via ports, while mechanically compressing the wall of the well by means of structures formed on the outside of the placement tool which act on the borehole wall as the drill string rotates.
- 17 The method as claimed in any of claims 12 to 16, wherein the activator is stored in a downhole reservoir located near the bottom of the drill string and arranged to inject slugs of activator into a drilling fluid.
- 18 The method as claimed in any preceding claims, wherein the bottomhole well temperature ranges from about 4°C to about 25°C.